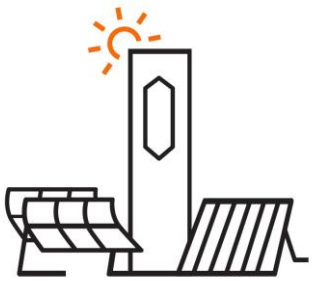
Strategic Energy Technology Plan

Implementation Working Group on STT

Thematic Vision on Solar Thermal Technologies



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Executive Summary

Solar thermal technologies (STT), encompassing both concentrated (CST) and non-concentrated (NCST) solutions, are well-positioned to make a substantial contribution to the energy transition, particularly addressing heating and cooling needs, which represent around 50% of EU energy demand. By delivering firm renewable electricity, district heating and cooling, and solar heat across all temperature ranges for buildings and industrial processes, as well as enabling green hydrogen and/or other solar fuels/chemicals/commodities production, STT directly support the EU's objectives of climate neutrality, energy security, and industrial competitiveness, while reducing fossil fuel imports and dependences, and reinforcing European industrial value chains. Mapping the solar thermal value chain in Europe can further help identify existing industrial and research strengths, as well as strategic gaps or dependencies, supporting targeted reindustrialisation actions.

The technology is driven by the need for decarbonisation of heating and cooling demand (across buildings, industry and district energy systems), as well as for flexible and secure renewable electricity, energy system resilience, and enhanced European manufacturing. However, key barriers include high upfront costs, perceived investor risks, intense global competition, fragmented policy frameworks, low recognition of solar heat and dispatchable electricity, permitting complexity, skills gaps, and limited support for low-to-medium Technology Readiness Level (TRL) innovation.

By 2030, the STT IWG aims to accelerate market uptake and demonstrate bankable solutions across diverse applications. Key targets include reducing solar heat for industrial processes (SHIP) costs below 2.5 c€/kWh for temperatures lower than 200 °C and below 3 c€/kWh for temperatures higher than 200 °C, electricity costs from Concentrated Solar Power (CSP) below 10 c€/kWh, next generation CSP power cycle reaching at least 42.4 % overall efficiency, and 15% reduction in NCST manufacturing costs, while increasing solar fraction for industrial processes, district heating networks and directly in buildings through net-zero energy buildings (NZEB). Key intermediate milestones by 2028 include launching commercial-scale solar thermal projects and pilots in selected SHIP sectors in Europe, large-scale demonstrators for photovoltaic thermal (PVT) hybrid solar collectors, and wider employment of digital tools and AI.

By 2040, STT is envisioned to evolve into system-critical infrastructure with multi-GW CSP deployment in Southern Europe, widespread use of SHIP and district heating and cooling, strong EU manufacturing base, standardised and bankable system designs, fully AI-supported operation, and deployment of integrated STT solutions in buildings. Respective targets foresee further cost reduction for SHIP applications below 2 c€/kWh for temperatures higher than 300 °C and dispatchable electricity costs below 7 c€/kWh. Intermediate milestones by 2035 include establishing procurement mechanisms for new CSP capacity and long-duration energy storage, support schemes for SHIP and district heating applications, integrating STT performance data into an EU federated Common Energy Data Space, validating STT hybrid plants with flexible and dispatchable operation, and replicating standardised STT system designs.

By 2050, STT will serve as a core pillar of a climate-neutral and resilient European energy system, fully integrated into technology-neutral energy markets based on system value, supplying direct solar heat across buildings, district heating and industry, alongside deca-GW scale of CSP electricity, and commercial-scale green hydrogen and/or other solar fuels/chemicals/commodities. Key intermediate milestones by 2045 include standardising AI-driven STT systems, implementing circular-by-design approaches, and deploying large-scale hybrid systems.

Finally, the IWG will task relevant industry and research actors with translating this Thematic Vision into a concrete Strategic Research and Innovation Agenda (SRIA) and will subsequently coordinate

multi-stakeholder discussions to identify and collect the Implementation and Investment Commitments needed to support this vision. For the next Multiannual Financial Framework (2028-2034), R&I should prioritise digitalisation, hybridisation with other renewables, system integration, reliable thermal energy storage, advanced materials, heat transfer fluids and/or components, and solar thermal conversion routes for fuels/chemicals/commodities production.

1. Introduction

General introduction to the IWG

The IWG on Solar Thermal Technologies (STT) is established by the SET Plan Steering Group (SG) to support the implementation of the SET Plan in this technology area. These technologies harness solar energy to generate thermal energy at various temperature levels, which can be used directly as heat or converted into other forms of energy, such as power, cooling or fuels/commodities. The IWG aims to strengthen research and innovation (R&I) cooperation and coordination among SET Plan countries and the EU, while also fostering political support, to advance STT as key renewable energy solutions contributing to the energy transition and the EU's objectives of climate neutrality, energy security, industrial competitiveness and decarbonisation, as well as technology sovereignty and independence. It works under the supervision of the SG to whom it reports regularly. To carry out its tasks, the IWG will benefit from the expertise, support and tools provided by the Commission (e.g. Joint Secretariats (CSAs), the SET Plan information system - SETIS, the Clean Energy Technology Observatory project, the Competitiveness Progress Report, workshops, events, etc.).

Objective of the Thematic Vision

The objective of this Thematic Vision is to define a shared outlook for the development, manufacturing and market uptake of STT in Europe. It evaluates current technological progress and establishes ambitious yet achievable targets for 2030, 2040 and 2050, serving as the building block for the development of the subsequent Strategic Research and Innovation Agenda (SRIA), which will translate this outlook and respective targets into concrete R&I priorities, key performance indicators (KPIs), and investment and funding needs.

Applications

The scope of the IWG encompasses all STT—both concentrated (CST) and non-concentrated (NCST)—and the full range of their market applications. STT are used across a wide range of temperature levels and benefit from thermal energy storage (TES) solutions to serve several common applications, including power generation with Concentrated Solar Power (CSP) plants or with photovoltaic thermal (PVT) hybrid solar collectors, solar heat for industrial processes (SHIP), district heating and cooling, decarbonisation of heating and cooling needs in buildings, as well as water desalination and purification when thermal processes are involved. In addition to these common applications, certain uses are specific to CST technologies, such as hydrogen and solar fuels production, and the thermochemical production of raw materials.

Key Developments

- *Recent developments:*
    - The SET Plan has expanded the mandate of the IWG to include both CST and NCST, ensuring a unified approach to solar thermal R&I.
    - STT are recognised as key technologies within the Net Zero Industry Act (NZIA) and the Green Deal Industrial Plan, and they contribute to the objectives of the Competitiveness Compass, the Clean Industrial Deal (including the Union of Skills) as well as to the requirements of the Critical Raw Materials Act and the Industrial Accelerator Act.
    - Increased focus on integration with photovoltaic (PV) and TES to reduce the cost of 24/7 dispatchable renewable electricity.

- Several R&D approaches are significantly advancing to propose a next-generation CST technology with increased feasibility: i) volumetric solar tower receivers; ii) particle solar tower receivers, iii) higher-temperature molten salts as heat transfer fluid (HTF) for solar towers, parabolic-trough collectors (PTC) or linear Fresnel reflectors (LFR); iv) silicon oil as HTF for PTC.
- Solar production of chemical commodities was proved at pilot scale.
- The growing interest in SHIP is driving technological advancements, supported by the expertise gained from newly installed STT plants.
- Emergence of PVT hybrid solar collectors providing both electricity and heat, also integrated with TES and heat pumps.
- Solar thermal is increasingly recognised for its role in district heating and cooling, and production of solar fuels and chemicals.
- Technological advancements and developments in digitalisation and artificial intelligence (AI) tools are improving operational efficiency and reducing operations and maintenance (O&M) costs.
- STT systems integrated with different TES options contribute to strong sector coupling systems/applications.

- *Key drivers:*

- Geopolitical issues call for reducing energy costs and dependence on fossil fuels and energy and commodities imports.
- Reduction of technological dependence on non-EU suppliers in line with the NZIA requirements.
- Intensifying international competition is a core driver for mapping the European solar thermal value chain; by evaluating regional research, innovation, manufacturing, and industrial capacities, critical dependencies to foster targeted reindustrialization can be exposed.
- STT typically does not rely on scarce or critical materials, nor on delocalised supply chains, reducing both environmental impact and exposure to geopolitical risks.
- Strong EU-wide drive to decarbonise the energy system, accelerating the deployment of renewable energy solutions to replace fossil-based supply.
- STT can significantly contribute to EU's industrial decarbonisation by directly providing heat, obviating the need to electrify industrial processes, and thus alleviating pressure on the electrical grid.
- CSP with TES provides dispatchable and flexible power to the grid, enabling on-demand generation, even during the night and cloudy periods.
- By supplying synchronous electricity, CSP ensures grid stability and resilience (in technical terms it provides natural system inertia, frequency/voltage regulation, and spinning reserves for enhanced dynamic performance).
- Heating and cooling needs represent ~50 % of EU energy consumption.
- Emergence of micro and mini CST/CSP systems for built-up areas.

- Policy developments (NZIA, Clean Industrial Deal, REPowerEU, Industry Accelerator Act and the forthcoming EU Heating and Cooling Strategy) improve the case for solar thermal by recognising non-price criteria in procurement mechanisms, such as resilience, innovation, sustainability and system value.
- STT plants contribute to local economic value creation and the generation of stable, high-quality employment, as their operation and maintenance demand a skilled and specialized workforce.
- A robust EU NCST manufacturing base (~100 production sites), supplying 90% of EU demand for NCST systems. Manufacturing using mostly EU-sourced materials and components.
- Europe has a strong research capacity base in CST technology, including a network of major scientific infrastructures organised around EU-SOLARIS ERIC, which enable the validation of new technologies at a near-industrial scale.

- *Key barriers:*
  - Economic and financial: high investment and financing costs (CAPEX for STT, OPEX for CSP), perceived investor risks, project bankability, intense global competition, and lack of EU-wide certification for large-scale systems.
  - Research and development (R&D): Limited public and private support for low to medium Technology Readiness Level (TRL) developments of innovative STT applications, such as local production of solar chemicals/commodities.
  - Legislative, regulatory, and administrative: fragmented national policy frameworks, uneven recognition of solar thermal in National Energy and Climate Plans (NECPs), complex and lengthy permitting procedures.
  - Structural and social: supply chain vulnerabilities, skills gaps, social acceptance, limited awareness among industrial end-users, policy makers and financing actors.

Focus areas

- Digital tools for design and O&M tasks (digital twins), AI-enhanced O&M, advanced forecasting models, and interoperable data frameworks.
- Enhancement of reliable, durable and low-cost TES systems (including seasonal storage, low and high temperature storage technologies).
- Advancing the implementation of high-performance, reliable, durable, low-cost and environmentally friendly materials, heat transfer fluids and/or components, for next-generation of STT collectors, including PVT ones.
- Advanced system integration for SHIP, solar district heating (SDH), and solar heating and cooling in buildings, enabling hybridisation with other technologies (multi-source systems) and flexible, demand-driven operation, as well as sector coupling.
- Innovation in solar-driven fuel and chemical production (e.g. hydrogen, ammonia, methane, methanol, ethene) and water treatment applications in agricultural, urban and industrial environments.

Task Force recommendations

- Circularity: high recyclability potential of STT components and materials (aluminium, glass, copper).
- Skills: educational and training programmes to address social sciences and humanities (SSH) aspects and the skills gap, mainly related to installer and engineering shortages across all STT applications.
- Digitalisation: need for interoperable data models and digital twins.
- Access to Market: importance of harmonised permitting, large-scale certification, project demonstration and de-risking, as well as wider use of the Important Projects of Common European Interest (IPCEI) instrument.
- Societal Needs: awareness raising, addressing affordability and energy poverty.

2. Vision and targets

2.1. Short-term (2030)

The short-term vision for STT is to strengthen the EU's leadership by achieving key technological and economic benchmarks by 2030. These respective targets are designed to enhance competitiveness and accelerate the decarbonisation and independence of the European energy system.

Cost, performance and competitiveness:

- For process temperatures lower than 200 °C, thermal energy cost for SHIP applications below 2.5 c€/kWh in Southern Europe locations, with optimised system integration enabling solar fractions of ≥40 %, considering system lifetime of 25 years.
- For process temperatures higher than 200 °C, thermal energy cost for SHIP applications below 3 c€/kWh in Southern Europe locations, considering 2000 kWh/m^2/year DNI resource as reference conditions and system lifetime of 25 years.
- Cost reduction of electricity provided during periods with low wind, PV or hydropower infeed, to values below 10 c€/kWh in Southern Europe locations, considering 2000 kWh/m^2/year DNI resource as reference conditions and no constraints regarding the size/type of the plant and Power Purchase Agreements (PPA), with system lifetime of 25 years.
- Development of next generation CSP (also named as solar thermal electricity, STE) plants achieving at least 42.4 % overall power cycle efficiency.
- Reduction of NCST collector (including PVT) manufacturing cost by 15 % (baseline 2024).[1]
- Reduction of levelised cost of heating and cooling (LCoHC) by ≥ 10 % for STT in buildings.[2]
- Reduction of thermal storage cost by 10 % (baseline 2024) for large-scale industrial storage systems, depending on technology maturity and application.[3]

[1] Baseline 2024 manufacturing costs for NCST collectors in Europe are estimated to range between approximately 120 and 200 €/m^2 for glazed flat plate collectors, between 180 and 280 €/m^2 for evacuated tube collectors, and between 50 and 100 €/m^2 for unglazed collectors typically used in low temperature applications. For hybrid PVT collectors, typical manufacturing cost ranges are estimated at approximately 250 to 400 €/m^2, depending on design, level of integration, and production scale.

[2] Baseline reference: For building integrated solar thermal technologies, typical LCoHC values in Europe are estimated, for the 2020–2024 period, to range approximately between 40 and 80 €/MWh_th for domestic hot water systems, between 50 and 100 €/MWh_th for combined space heating and domestic hot water systems, and between 60 and 120 €/MWh_th for solar thermal systems providing heating services, depending on building type, climate zone, system configuration, and financing assumptions.

[3] Baseline 2024 thermal storage costs for large-scale industrial applications range between approximately 20 and 60 €/kWh$_{th}$, depending on technology, temperature, size, and integration. Sensible heat systems are typically at the lower end, while phase-change systems are at the upper end.

- Validation of large-scale seasonal storage costs in the range of 0.4 to 1.5 €/kWh, under real operating conditions.[4]
- Integration of AI-based design/operation tools with ≥15 % performance improvement.

Innovation and technology demonstration:

- At least one First of a Kind (FOAK) commercial plant integrated in the energy system, demonstrating either the cost reduction or the efficiency increase in Southern Europe.
- Demonstration of economically viable solar thermal baseload production of green hydrogen and/or other solar fuels/chemicals/commodities.
- Recyclability of ≥85 % for NCST collectors and ≥60 % for PVT collectors.
- Demonstration of solar fraction ≥50 % for industrial processes.
- Demonstration of solar fraction ≥25 % without seasonal storage in new or retrofitted SDH networks.
- Demonstration of combined efficiency (heat and electricity) ≥60 % for hybrid systems such as PVT at 40 °C (compact NCST) or CST with other RES.
- Demonstration of advanced multi-source systems using STT with other RES in buildings, industry and DH-networks for flexible, demand-driven operation.

Deployment and market uptake:

- NECP -aligned deployment demonstrating scalable market uptake:
    - Spain: 4804 MW of CSP installed capacity.
    - Italy: 80 MW of CSP installed capacity.
    - Portugal: 164 ktoe/year of heat by solar thermal (with existing measures), plus 20 ktoe/year with additional measures, in the heating and cooling sector.
- Deployment and retrofitting of CST plants with long-duration storage (≥8 hours) enabling firm renewable energy supply and system flexibility.
- All new STT plants installed in Europe integrating TES.
- Deployment of STT solutions for buildings with solar fractions of ≥70 % (Mediterranean), ≥65 % (Continental), ≥50 % (Nordic) for domestic hot water (DHW) and space heating in nearly zero energy buildings (NZEB)/deep retrofit projects.
- Establishment of an open database with performance data from ≥1,000 systems.

[4] Baseline 2024: Large-scale seasonal thermal storage systems (e.g. PTES, UTES) typically range between 0.4 and 1.5 €/kWh_{th}, depending on size, design, and conditions. The ≤1.5 €/kWh_{th} is a validation targe, i.e. it reflects validation of commercially available solutions at large scale under real operating conditions.

Milestones (by end of 2028):

- Launch of at least 2 commercial-scale solar thermal projects in Europe, including hybrid systems.
- Demonstration of industrial process heat applications with process temperatures higher than 200 °C approaching the cost target (3 c€/kWh).
- Commercial pilots in at least three SHIP sectors (e.g., food, textile, chemical).
- At least 5 large-scale pilots of PVT systems in the building, industry and DH sectors that make efficient use of both electricity and heat.
- Demonstration of digital tools in solar thermal plants (predictive maintenance, data integration, digital twins, forecast) and progress on EU data interoperability frameworks.
- Implementation of de-risking financing instruments and improved permitting procedures in Member States.

Enabling conditions:

- Market designs and remuneration schemes that recognise the value of dispatchability, flexibility and system services for grid integrity and stability (e.g., ancillary services).
- De-risking financial instruments and innovation funding schemes that accelerate investment and scale-up.
- Streamlined permitting, improved urban/spatial planning and access to DH networks and electricity grid, and promotion of cross-border cooperation mechanisms.
- Creation of industry awareness of integrated heat and chemicals producing solar devices for high valuable products.
- A well-developed and competitive European solar thermal value chain, supported by improved mapping of industrial and research and innovation capacities, a strengthened skills base and circular economy practices.
- Strengthened solar thermal manufacturing capacity, reducing external dependencies and enhancing resilience.

Cross-cutting priorities:

- Digitalisation: data-driven predictive operation and maintenance, interoperability and integration into smart energy systems.
- Circularity: improvement of material intensity and durability, environmental footprint and recycling of solar thermal components.
- Skills: large-scale upskilling/reskilling programmes to support deployment.
- Societal needs: affordability, public acceptance, and just transition.
- Technological neutrality: multi-source applications and hybridisation with other RES technologies, waste heat and integration of TES.

IWG activities:

IWG activities and the respective fiches will be included as additional annex to the SRIA.

2.2. Medium-term (2040)

The medium-term vision for STT is to evolve from deployed solutions to system-critical infrastructure/assets, delivering firm renewable energy at scale, while positioning Europe as a global industrial leader in flexible solar energy, in line with the SET Plan principles, while contributing to energy and technology independency.

Cost, performance and competitiveness:

- Thermal energy cost for industrial process heat applications below 2 c€/kWh for the same Southern Europe locations, with process temperatures higher than 300 °C.
- Cost reduction of dispatchable electricity delivered in "low variable renewable energy (VRE) infeed periods" to values below 7 c€/kWh in Southern Europe locations, ensuring competitiveness in technology-neutral procurement of firm power.
- Reduction of seasonal storage cost in the range of 0.8–1.0 €/kWh_{th}.[5]
- European technology leadership across the STT value chain, with strong EU-based manufacturing (>80 % of EU demand) and export (>15 % of capacity produced) volume.
- Performance and cost-efficiency improvements using hybrid STT systems (including PVT), enabling optimised combined heat and electricity generation and enhanced system value.

Innovation and technology demonstration:

- Transition to fully standardised, replicable and bankable solutions across STT applications.
- Full digitalisation and integration of AI-driven tools in STT systems with interoperable data frameworks.
- Integration of self-diagnostic, self-calibrating and other smart sensors into solar thermal systems.
- Integration of STT with next generation large-scale TES at medium and high temperature levels from multiple heat sources (including seasonal storage).
- Large-scale demonstration of STT solutions in industrial process heat and DH networks, achieving high solar fractions under real operating conditions.
- Demonstration of STT hybrid plants integrating thermal storage and other RES technology interfaces (e.g., STT-PV, STT-wind, STT-geothermal, STT-heat pumps, etc.), across buildings, industry, district heating, and electricity applications.

[5] The 2040 target of 0.8-1.0 €/kWh_{th} reflects cost reductions from scaling, standardisation, and wider deployment, building on current large-scale seasonal storage performance.

- Large-scale demonstration of economically viable solar thermal baseload production of green hydrogen and/or other solar fuels/chemicals/commodities.
- Demonstration of advanced PVT collectors in different applications.

Deployment and market uptake:

- NECP-aligned deployment demonstrating scalable market uptake:
    - Portugal:
        - 600 MW of CSP installed capacity.
        - 223 ktoe/year of heat by solar thermal (with existing measures) in the heating and cooling sector.
- Multi-GW scale of new CSP installed capacity in Southern Europe.
- Contribution to reducing overall energy system costs and curtailment of variable renewables.
- Large-scale deployment of STT for low to medium-temperature industrial process heat (≤400 °C), supporting decarbonisation of key sectors such as food, textiles and specific chemical processes.
- Deployment of CST plants with long-duration storage exceeding 16 hours as a key provider of firm and secure renewable energy supply.
- STT as the primary heat source for ≥2 % of European district heating networks.
- At least 4 Member States include STT-specific targets in national strategies/NECPs.
- Widespread deployment of integrated and hybrid STT solutions in buildings, supporting decarbonised heating and cooling, targeting ≥40 % of new and deeply renovated buildings.

Milestones (by end of 2035):

- Procurement mechanisms for new CSP capacity in Southern European countries.
- Procurement mechanisms for long-duration energy storage for system flexibility in European countries.
- Implementation of procurement or support schemes enabling large-scale deployment of STT in industrial process heat and district heating applications.
- Full integration of STT performance data into an EU federated Common Energy Data Space.
- Validation of STT hybrid plants demonstrating flexible, dispatchable operation under diverse meteorological conditions.
- Standardisation and replication of STT system designs across key applications, enabling reduced project development time and costs.

Enabling conditions:

- Policy and market frameworks that explicitly remunerate dispatchability, flexibility and system services for grid stability, resilience, and security.
- Policy frameworks that recognise and support renewable heat solutions, including STT, in buildings, district heating and industrial sectors.
- De-risking and financing mechanisms enabling scale-up of integrated projects.
- Accelerated permitting for STT projects within strategic net-zero acceleration zones.
- Aligned energy and industrial policies supporting EU-based manufacturing of key STT components, within a strengthened and resilient European solar thermal value chain to enhance competitiveness, while reducing external dependencies.
- Development of standards and certification schemes for multi-technology and multi-vector systems, sector coupling applications, as well as for component lifetime for medium and high temperature applications.

Cross-cutting priorities:

- Digitalisation and AI: Implementation of common data infrastructure, interoperability standards, and data structures for energy technologies.
- Circularity: Advances in circular by design approach, strengthening domestic supply of circular materials.
- Security and resilience: reduction of external dependencies, improvement of energy resilience.
- Skills: strengthening of education-industry links, integration of multi-disciplinary skills, upskilling/reskilling of workforce for multi-technology projects.
- Societal needs: embedding societal needs into technology development and deployment choices.

IWG activities:

IWG activities and the respective fiches will be included as additional annex to the SRIA.

2.3. Long-term (2050)

The long-term vision for STT is to become a core pillar of a climate-neutral, secure, independent and resilient European energy system, delivering firm renewable electricity, low- to high-temperature heat for buildings, district heating networks, and industrial processes, and as well as solar fuels at scale.

Cost, performance and competitiveness:

- STT solutions integrated into technology-neutral energy markets on the basis of system value: dispatchability, storage duration, resilience, circularity and avoided system costs.
- Cost-competitive STT plants across the full temperature range without the need for supporting schemes.
- European leadership in STT engineering, TES, system integration and optimisation services.

- European industrial dominance on STT systems and key components as well as project deployment in the global STT market.

Innovation and technology demonstration:

- Commercial maturity of fully digitalised AI-driven STT systems with autonomous operation and system-wide optimisation.
- Standardised commercial STT hybrid plants integrating TES and other RES technology interfaces (e.g., STT-PV, STT-wind, STT-geothermal, STT-heat pumps, waste heat, etc.), across buildings, industry, district heating, water treatment and electricity applications.
- Standardised STT-based commercial production of green hydrogen and/or other solar fuels/chemicals/commodities.

Deployment and market uptake:

- STT as a mainstream energy solution across all thermal applications, including buildings, district heating and industrial processes, contributing substantially to heat demand for any temperature range.
- Deca-GW scale of new CSP installed capacity in Southern Europe.
- STT as the primary vector for direct heat in EU's industrial decarbonisation.

Milestones (by end of 2045):

- Large-scale deployment of STT-based hybrid systems across buildings, district heating, industry and electricity applications.
- Full integration of STT into energy markets and planning frameworks based on system value (flexibility, dispatchability, resilience and renewable heat).
- Standardisation of digitalised, AI-driven STT systems enabling optimised operation and predictive maintenance.
- Full implementation of circular-by-design approaches across the STT value chain.

Enabling conditions:

- A fully integrated European energy market that values grid services and renewable heat contributing to flexibility, security of supply, and resilience of the energy system.
- Established industrial policies promoting EU-manufactured solutions and creation of local content in RES project development.
- Streamlined EU-wide permitting and stable long-term investment frameworks for STT and hybrid RES systems.

Cross-cutting priorities:

- Digitalisation and AI: Full integration of AI-driven autonomous systems, digital twins, and predictive O&M across all STT applications.
- Circularity: Fully circular STT manufacturing with ultra-high material recovery rate.

- Security and resilience: Technological sovereignty in STT design, manufacturing and operation; elimination of external dependencies.
- Skills: STT integrated into mainstream energy engineering education; European workforce specialised in system integration, digital tools, hybrid plant design and O&M.
- Societal needs: Addressing energy poverty via full integration of societal needs into RES technological development and project deployment.

IWG activities:

IWG activities and the respective fiches will be included as additional annex to the SRIA.

3. Conclusions and next steps

STT can become a strategic pillar of Europe's decarbonised energy system by contributing to SHIP, district heating and cooling, heating and cooling needs in buildings, power generation, production of hydrogen and other solar fuels/chemicals/commodities, integration of long-duration TES, and hybridisation with other RES. Achieving this role requires a coordinated effort at the EU and Member State level to move from fragmented demonstrations to standardised, bankable and scalable solutions. In this context, the completion of this Thematic Vision marks the successful delivery of the first core component by the STT IWG towards the development of the Common Implementation and Investment Plans under the SET Plan.

In line with the IWG mandate, the drafting of the SRIA will be entrusted to the relevant industry and research stakeholders, represented by the European Solar Thermal Electricity Association (ESTELA), Solar Heat Europe (SHE), EU-SOLARIS ERIC and EERA JP CSP. The SRIA shall translate this Thematic Vision into concrete R&I priorities and activities, KPIs, and funding needs, and will also include recommendations and/or enabling framework conditions where relevant. The IWG will then coordinate multi-stakeholder discussions involving Member States, the European Commission, industry, research organisations and academia, to seek consensus on identifying and collecting Implementation and Investment Commitments.

The SRIA development process should ensure alignment with other SET Plan activities. Synergies are particularly relevant with:

- IWG Integrated Energy Systems
- IWG Sustainable and efficient energy use in industry
- IWG Resource and Energy Efficiency in Buildings
- IWG Geothermal
- IWG Hydrogen
- IWG Positive Energy Districts
- IWG Batteries
- European Technology and Innovation Platform on Renewable Heating and Cooling (RHC ETIP)

In addition, cooperation with SUN2X-SET Coordination and Support Action (CSA) will be pursued on solar thermal conversion linked to Direct Solar Fuels.

Furthermore, ensuring success of the next steps will require dedicated focus on the cross-cutting priorities established in this Thematic Vision, most notably advancing the implementation of safe and circular-by-design approaches to ensure high recyclability across the value chain, and launching large-scale upskilling and reskilling educational programmes to close the skills gap and workforce shortage in Europe.

References

European Commission - National Energy and Climate Plans (2024). Austria - Final updated NECP 2021 - 2030 (submitted 2024).

European Commission - National Energy and Climate Plans (2024). Cyprus - Final updated NECP 2021-2030 (submitted in 2024).

European Commission - National Energy and Climate Plans (2024). France - Final updated NECP 2021-2030 (submitted in 2024).

European Commission - National Energy and Climate Plans (2024). Germany - Final updated NECP 2021-2030 (submitted in 2024).

European Commission - National Energy and Climate Plans (2024). Italy - Final updated NECP 2021-2030 (submitted in 2024).

European Commission - National Energy and Climate Plans (2024). Portugal - Final updated NECP 2021-2030 (submitted in 2024).

European Commission - National Energy and Climate Plans (2024). Spain - Final updated NECP 2021-2030 (submitted 2024).

European Commission - National Energy and Climate Plans (2025). Greece - Final updated NECP 2021-2030 (submitted in 2025).

European Commission - National Energy and Climate Plans (2025). Slovakia - Final updated NECP 2021-2030 (submitted in 2025).

European Commission - National Energy and Climate Plans (2025). Slovenia - Final updated NECP 2021-2030 (submitted in 2025).

European Commission - SET Plan (2023). Initiative for Global Leadership in Concentrated Solar Thermal Technologies: Updated Implementation Plan.

European Commission - SET Plan (2025). Initiative for Global Leadership in Solar Thermal Technologies: Implementation Plan on Non-Concentrated Solar Thermal (NCST).

European Commission - SET Plan (2025). Strategic Energy Technology (SET) Plan Governance.

European Commission - SET Plan (2026). Mandate for SET Plan Implementation Working Group (IWG) on Solar Thermal Technologies (STT).

European Commission - SET Plan (2026). SET Plan Principles: Guidance document for Common Implementation and Investment Plans (CIIPs) and a Common Strategic Vision.

European Commission (2022). COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS. REPowerEU Plan (COM/2022/230 final).

European Commission (2022). COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS. EU Solar Energy Strategy (SWD/2022/148 final).

European Commission (2023). COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS. A Green Deal Industrial Plan for the Net-Zero Age (COM/2023/62 final).

European Commission (2024). COMMISSION STAFF WORKING DOCUMENT Solar energy joint research and innovation agenda with Member States in the context of the European Research Area (ERA) (SWD/2024/160 final).

European Commission (2025). COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS. The Clean Industrial Deal: A joint roadmap for competitiveness and decarbonisation (COM/2025/85 final).

European Commission (2025). COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS. A Competitiveness Compass for the EU (COM/2025/30 final).

European Commission (2025). Consolidated text: Regulation (EU) 2024/1735 of the European Parliament and of the Council of 13 June 2024 on establishing a framework of measures for strengthening Europe's net-zero technology manufacturing ecosystem and amending Regulation (EU) 2018/1724 (Text with EEA relevance).

European Commission (2026). Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL establishing a framework of measures for the acceleration of industrial capacity and decarbonisation in strategic sectors and amending Regulations (EU) 2018/1724, (EU) 2024/1735 and (EU) 2024/3110 (COM/2026/100 final).

European Technology and Innovation Platform on Renewable Heating and Cooling (2019). 2050 vision for 100 % renewable heating and cooling in Europe.

European Technology and Innovation Platform on Renewable Heating and Cooling (2022). Strategic Research & Innovation Agenda for Solar Thermal Technologies.

European Technology and Innovation Platform on Renewable Heating and Cooling (2022). STRATEGIC RESEARCH AND INNOVATION AGENDA FOR CLIMATE-NEUTRAL HEATING AND COOLING IN EUROPE.

Genikomsakis, K, Heller, P, Benitez, D, Blanco Galvez, J, Sanchez Moreno, R, Turchetti, L, Baker, D, Eryilmaz, H, Erden-Topal, Y, (2025). "Final workshop report incorporating cross-technology roadmaps", EU Horizon Europe Project CST4ALL (GA No.: 101075408).